Heat Capacity (specific heat) problem

What's it look like

You are given: ***initial temp*** of two different substances (often a piece of metal and water), ***final temp*** after the two are put together, ***mass*** of each, and the ***specific heat*** for one of the substances (often water: 4.18 J/g·K)

Ex: 15.0 g of a metal with an initial temperature of 340. °C *is immersed in 250.0 g of water at an initial temperature of 25.0* °C. *The final temperature of the mixture is 30.2* °C. *What is the specific heat of the unknown metal?*

Concept behind it

The energy flows from the hotter substance to the cooler substance until they reach the same temperature.

How to tackle it

For the substance you know the specific heat for, use the change in temp, mass and specific heat to solve for the change in energy. Then use that change in energy and the mass and change in temp for the second substance to find its heat capacity.

Detailed steps

1) Use the equation for specific heat capacity ($q=mc\Delta T$) for the substance where c (the specific heat capacity is known) and solve for q.
2) Rearrange the equation to sove for "c" for the other material: $c=q/m\Delta T$ (be sure to use the correct mass and change in temperature for the other material.

Alternative method:

1) Set the energy lost by one substance equal to the energy gained by the other substance: $m_1\ c_1\ \Delta T_1 = m_2\ c_2\ \Delta T_2$
2) Solve for the unknown "c" (specific heat).

Example (continued from above):

Two step method:

$q = mc\Delta T = 250.0\ g \cdot 4.18\ J/g{\cdot}K \cdot 5.2\ K = 5434\ J$

$c = q/m\Delta T = 5434\ J/(15.0\ g \cdot 219.8\ K) = 1.648164998\ J/g{\cdot}K = 1.65\ J/g{\cdot}K$

Alternative one step method:

$m_1\ c_1\ \Delta T_1 = m_2\ c_2\ \Delta T_2$

$250.0\ g \cdot 4.18\ J/g{\cdot}K \cdot 5.2\ K = 15.0\ g \cdot c_2 \cdot 219.8\ K$

$$c = \frac{250.0\ \text{g} \bullet 4.18\ \text{J/(g}\bullet\text{K)} \bullet 5.2\ \text{K}}{15.0\ \text{g} \bullet 219.8\ \text{K}} = 1.648164998\ J/g{\cdot}K = 1.65\ J/g{\cdot}K$$